

# Yuan Gao

Optical Sensing & Perception R&D | Ph.D. in Engineering

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Optical sensing and perception engineer with a Ph.D. from The University of Osaka and a physics background. I develop compact vision-based tactile sensors, connecting imaging models and hardware prototyping with calibration, 3D reconstruction and experimental evaluation. First author of four peer-reviewed journal papers. Seeking industry research and engineering opportunities in Japan.

## WORK EXPERIENCE

### Algorithm Engineer | May 2026 - present

Shanghai Aerospace Control Technology Institute, China

Develop 3D point-cloud algorithms for object pose estimation: extract linear structures using local PCA at multiple neighborhood scales, align feature axes for coarse registration, and refine the pose with ICP.

## RESEARCH AND DEVELOPMENT

### Compact vision-based tactile sensors | 2021 - 2026

Doctoral research, The University of Osaka. Lead researcher and first author across three sensor generations. Responsible for problem definition, optical and mechanical design, fabrication, calibration, evaluation and writing.

- **Folded optics and fluorescent illumination.** Developed an approximately 44 x 16 x 14 mm sensor. Optimized camera and mirror placement under field-of-view and occlusion constraints. Used fluorescent coatings excited by white LEDs to provide directional color illumination. Purchased prototype materials cost under US\$20.
- **Lensless pinhole imaging.** Reduced thickness from 34 to 15 mm compared with a lens-based design using the same camera and field of view. Modeled geometric blur, diffraction, refraction, effective aperture thickness and field-of-view constraints; built and calibrated the physical prototype.
- **Rotational scanning.** Expanded effective sensing width from 10 to 28 mm with a thin geared mechanism and rear-mounted motor. Used marker tracking, least squares and RANSAC to estimate the rotation center, then registered and blended overlapping images. Evaluated the acquisition-time trade-off.
- **Calibration and evaluation.** Built color-to-gradient lookup tables and photometric depth reconstruction pipelines. Evaluated reconstruction error, image sharpness and repeatability. Ten repeated presses per object yielded mean per-pixel depth standard deviations of 0.063-0.097 mm for a sphere, screw and wrench.

### In-hand pose estimation with vision and touch | 2020 - 2023

First-author laboratory research, The University of Osaka.

- Built and integrated two fingertip tactile sensors with two palm-mounted RGB cameras. Trained the networks, operated the estimation pipeline and conducted real-robot experiments. A coauthor implemented the network code.
- Evaluated combined vision-and-touch sensing with varied object materials and demonstrated pipette insertion into a transparent test tube. Led the paper writing.

# Yuan Gao

Technical skills, education and publications

## TECHNICAL SKILLS

**Optical sensing:** imaging geometry, pinhole imaging, diffraction and refraction, folded optics, fluorescent illumination, constrained layout optimization.

**Perception and software:** Python, NumPy, OpenCV, photometric stereo, camera and fisheye calibration, marker tracking, RANSAC, image registration and blending, local PCA, ICP.

**Prototyping:** Onshape, Autodesk Inventor, 3D printing, laser cutting, soldering, CMOS camera integration, pinhole fabrication and microscopy, elastomers and optical coatings.

## EDUCATION

**Ph.D. in Engineering, The University of Osaka** | Apr 2021 - Mar 2026

Graduate School of Engineering Science, Department of Systems Innovation. Supervisor: Prof. Kensuke Harada.

**M.Eng., The University of Osaka** | Apr 2019 - Mar 2021

Same graduate school and department. Research student: Nov 2018 - Mar 2019.

**B.Sc. in Physics, Zhejiang University** | Sep 2014 - Jun 2018

Chu Kochen Honors College, Qiushi Science Class (Physics).

## LANGUAGES

**Chinese:** native. **Japanese:** JLPT N2 (July 2019); technical reading and writing, technical discussions with preparation. Studied in Japan during 2018-2026. **English:** TOEFL iBT 96 (2017); four first-author journal papers written in English.

## SELECTED PUBLICATIONS - ALL FIRST AUTHOR

Y. Gao et al. "A Thin Pinhole-Based Tactile Sensor With Rotational Scanning for Field-of-View Expansion." *IEEE Sensors Journal*, 26(8), 11778-11787, 2026. doi:10.1109/JSEN.2026.3668906

Y. Gao et al. "Development of a Compact Tactile Sensor Using a Pinhole RGB Camera." *IEEE Sensors Journal*, 25(19), 36074-36084, 2025. doi:10.1109/JSEN.2025.3604943

Y. Gao et al. "Development of a Miniature Photometric Vision-Based Tactile Sensor." *IEEE Sensors Journal*, 24(20), 32053-32064, 2024. doi:10.1109/JSEN.2024.3452768

Y. Gao et al. "In-Hand Pose Estimation Using Hand-Mounted RGB Cameras and Visuotactile Sensors." *IEEE Access*, 11, 17218-17232, 2023. doi:10.1109/ACCESS.2023.3244552

## AWARDS AND ADDITIONAL ENGINEERING

**2024:** 5th Excellent Research and Technology Award, Robotics Society of Japan, for miniature tactile-sensing research.

**2016:** National runner-up, 7th China Undergraduate Physics Tournament, Zhejiang University team.

**Gameplay recording analysis (2020-2022):** independently developed score recognition and optimal timing search using image processing. Coordinated about ten collaborators; covered 4,000+ charts for 1,000+ users.